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(54) TREATMENT OF A LIQUID BY MEANS OF A GASEOUS FLUID

(71) We, JONES & ATTWOOD LIMITED of Titan Works, Stourbridge, in the County of Worcester, a British Company, do hereby declare the invention for which we pray that a Patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to an installation for the treatment of a liquid by means of a gaseous fluid.

In various industries and in particular in the sphere of the treatment of water it is frequently necessary to gasify a liquid in order to obtain certain chemical or biological reactions, to saturate the liquid with a gas or to eliminate materials in suspension near the surface of the liquid by flotation, and so on.

Generally, this gasification is carried out by blowing gas under pressure into the liquid mass or by projecting liquid in a gaseous medium, or by means of rotary stirrers in combination with the blowing of gas under pressure below the blades of the stirrer.

The object of the present invention is to provide an improved installation for the treatment of a liquid by means of a gaseous fluid.

According to the invention there is provided an installation for the treatment of a liquid by means of a gaseous fluid, comprising a basin adapted to contain the liquid to be treated, a supply conduit for supplying raw or crude liquid to the basin and an evacuation conduit for the treated liquid, a rotary centrifugal pump for dispersing the gaseous fluid in the liquid, said pump being mounted on a rotatable shaft, a mixing member in the form of a helical propeller disposed beneath the pump and mounted on said rotatable shaft, a supply conduit which is adapted to supply gaseous fluid to the pump and which forms a guide tube surrounding said shaft, characterised in that there is provided a sleeve which surrounds said pump and which provides an annular space between the pump and the interior of the sleeve, said sleeve having at its lower end a tubular extension which surrounds said mixing member so that in use the sleeve is wholly immersed in liquid in the basin, the arrangement being such that in use the pump injects gaseous fluid into the liquid only in said annular space between the sleeve and the pump, the liquid being caused to flow through said annular space by the helical propeller.

The invention will now be described with reference to the accompanying drawing, which shows one embodiment of an installation in accordance with the invention, in axial section, but in no restrictive sense.

On referring to the drawing, it can be seen that the installation shown therein comprises a basin, or vat 1 adapted to contain the liquid 2 to be treated, said basin preferably having a circular cross-section. At the centre of the basin 1 a sleeve 3 is arranged which is open at its upper end and whose upper edge 4 is located below the constant level 5 of the liquid 2. The bottom 6 of the sleeve 3 is of frusto-conical shape and terminates at its centre in a tubular extension 7 directed towards the bottom 8 of the basin 1, which, in the embodiment illustrated, is in the form of a hopper, also of frusto-conical shape. The sleeve 3, which for instance can be constructed of metal sheet or of cement or other material, is coaxial with a guide tube 9 which is itself co-axial with the basin 1, the sleeve being connected to the guide tube by support members 10. In the interior of the guide tube 9, a shaft 11 is arranged, adapted to be driven by an electric motor 12 carried by the upper end of the said tube 9 and the latter is provided with an orifice 13 for suctioning gas, disposed above the level 5 of the liquid 2. The guide tube 9 at its lower end has a small collar or flange 14 carrying

on its periphery a plurality of ribs 15 which constitute the diffuser of a centrifugal pump, the wheel 16 of which is carried by the shaft 11. Said collar or flange 14 and the diffuser 15 constitute half the body of the pump whilst the wheel 16 is in the form of a disc provided on its upper surface with radial ribs 17. On the end of the shaft 11, below the wheel 16, there is provided a helical member 18 which constitutes a helical mixing propeller for the liquid. The sleeve 3, the guide tube 9 and the drive motor 12 for the shaft 11, for the wheel 16 and for the helical mixing propeller 18, are all supported in the centre of the basin 1 by means of crosspieces or support rails 23.

The liquid to be treated is supplied to the basin 1 via a conduit 19 which leads into the interior of the sleeve 3. A conduit 20 for the evacuation of the treated liquid is connected to the lower portion of the basin 1, i.e. in proximity to the bottom 8 of the said basin, the height of an overflow pipe 21, to which the said evacuation conduit 20 is connected, determining the level 5 of the liquid 2 in the basin 1.

The functioning of the installation described above is as follows: the liquid to be gasified flows through the conduit 19 to the interior of the sleeve 3. The level 5 of the liquid 2 to be treated corresponds to the height of the overflow pipe 21. The gas to be introduced into the liquid 2 is supplied to the suction orifice 13 made in the tube 9. When the motor 12 is running, it causes the wheel of the pump 16, and also the helical mixing propeller 18, to rotate and with one direction of rotation of the motor 12, the liquid is drawn from the bottom of the basin 1 towards the interior of the sleeve 3 through the tubular extension 7 surrounding the helical mixing propeller 18, in the direction indicated by the arrows shown in thick lines on the left-hand side of the drawing. The liquid accordingly passes through a reduced space 22 surrounding the diffuser 15. Meanwhile, the gas projected by the pump wheel 16 and its blades 17 through the diffuser 15, is finely dispersed in said space 22 through which the liquid to be treated is forced to pass. The result is accordingly a thorough mixing of the gas and the liquid, the resulting mixture rising in the interior of the sleeve 3. The gas which is not dissolved in the liquid then escapes to the surface 5 of the liquid. The duration of the contact of the gas with the liquid is accordingly a function of the distance between the space 22 and the surface 5 of the liquid 2. If it is desired to extend the duration of the gas/liquid contact, the motor 12 is operated in the reverse direction, as shown on the right-hand side of the Figure, in dotted arrows. In this case, the direction of the current resulting from the rotation of the helical mixing propeller 18 is accordingly reversed. Liquid is thus drawn from the top of the sleeve 3 and then passes through the reduced space 22 where it is gasified, the gas/liquid mixture then being forced by the helical mixing propeller 18 towards the bottom 8 of the basin 1. It will accordingly be observed that the longer the tubular extension 7 is, and the greater the distance of the bottom 8 of the basin 1 from the space 22, the greater will be the duration of contact of the gas/liquid mixture. In actual fact, the non-dissolved gas in the liquid has to rise again between the sleeve 3 and the basin 1 before reaching the surface 5, where it can escape.

Of course, in either case, by varying the rotation speed of the motor 12, it is possible to regulate the volume of gas introduced and the rate of mixing of the liquid.

The basin or vat 1 can be closed at its upper portion, if the nature of the gases to be introduced into the liquid mass requires this. This can for instance be the case if the gas is a toxic or rare gas, or an explosive gas to be recovered and to be circulated in closed circuit in the interior of the installation. On the other hand, if the installation is used only for the simple separation of a liquid mass, the basin 1 can be open.

The advantage of the method described above resides in particular in the fact that the liquid to be treated is forced to circulate and to pass in direct proximity to the gas injection, thus ensuring uniform gasification of the liquid mass, without creating zones where the gasification is better in comparison with other zones, as is the case with known methods. This advantage is all the more marked in that only a reduced volume of the liquid mass 2 is treated at one time by gas diffusion, i.e. only the volume contained in the interior of the sleeve 3. Of course the treatment of the liquid is continued by the injection of the said primary gasified liquid mass into the secondary liquid mass 2 still in the raw or crude state.

It is possible moreover, by selecting the direction of circulation of the liquid propelled by the helical mixing propeller 18, depending on the conditions of treatment desired, to shorten or to prolong the duration of contact of the liquid with the gas, simply by causing the liquid to circulate in such a way that it either rises or falls in the interior of the sleeve 3. Of course the electric motor 12 should be able to function in the two directions of rotation and, desirably, at different rotation speeds, in order that the degree of diffusion of gas can be adjusted as required.

WHAT WE CLAIM IS:—

1. An installation for the treatment of a liquid by means of a gaseous fluid comprising a basin adapted to contain the liquid to be treated, a supply conduit for supplying

raw or crude liquid to the basin and an evacuation conduit for the treated liquid, a rotary centrifugal pump for dispersing the gaseous fluid in the liquid, said pump being mounted on a rotatable shaft, a mixing member in the form of a helical propeller disposed beneath the pump and mounted on said rotatable shaft, a supply conduit which is adapted to supply gaseous fluid to the pump and which forms a guide tube surrounding said shaft, characterised in that there is provided a sleeve which surrounds said pump and which provides an annular space between the pump and the interior of the sleeve, said sleeve having at its lower end a tubular extension which surrounds said mixing member so that in use the sleeve is wholly immersed in liquid in the basin, the arrangement being such that in use the pump injects gaseous fluid into the liquid only in said annular space between the sleeve and the pump, the liquid being caused to flow through the said annular space by the helical propeller.

2. An installation as claimed in claim 1 characterised in that there is provided a motor for driving the rotatable shaft, said motor being adapted to drive the shaft in either direction of rotation.

3. An installation as claimed in claim 1 or claim 2 characterised in that the supply conduit for the crude liquid leads into the interior of the sleeve, the conduit for evacuation of liquid being connected to the bottom of the basin.

4. An installation as claimed in any one of the preceding claims characterised in that the lower end of said guide tube carries at its lower end a collar or flange which is provided with ribs forming a diffuser for the pump.

5. An installation as claimed in any one of the preceding claims characterised in that the upper part of said sleeve is connected to said tubular extension surrounding the helical mixing propeller by means of a frusto-conical portion.

6. An installation as claimed in any one of the preceding claims characterised in that the bottom of the basin is in the form of a hopper, whose lower zone is disposed opposite to said tubular extension.

7. An installation for the treatment of a liquid by means of a gaseous fluid comprising the combination and arrangement of parts substantially as hereinbefore described with reference to and as shown in the accompanying drawing.

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COMPLETE SPECIFICATION

This drawing is a reproduction of the Original on a reduced scale.